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Description

Field of the Invention

This invention relates to dot matrix printers in general and to print head suspension or carrier systems for such printers in particular, and to drive mechanisms for oscillating the print head carrier or suspension systems therein.

Prior art

A wide variety of dot matrix print mechanisms are known, of course. Those employing a shuttle principle in which print heads are affixed to a movable carrier are commonplace, but those in which the print heads and the carrier move together as a single piece are relatively few. Only U.S. Patent 4,127,334 is presently known to the applicant for this latter type of design.

This patent utilizes a generally E-shaped pair of flexible spring elements to support a rigid frame on which are mounted one or more print heads for reciprocation along a print line. The E-shaped spring elements are known to provide a linear translation when the top and bottom legs of the E-shaped springs are anchored to framework and the center leg is flexed back and forth. Two sets of such E-shaped springs are employed in this known patent, with one set of springs at each end of a general printing region and with the print head framework being affixed to the center legs of the E-shaped springs. This obscures the printing since the line of print produced is in a lower vertical position than the top of the springs. This patent also includes an off-center crank reciprocating driving means operating as an ordinary connecting rod and crank mechanism. This mechanism introduces forces which are not in the desired line of travel and hence introduces unwanted vibrations in a direction perpendicular to the desired printing line. Also, such a mechanism cannot impart a linear velocity to the print head framework and, therefore, makes the control of the printing operation much more complex. In addition, this patent employs command springs built up from several pieces requiring mechanical affixation in an interconnection with the other elements such as the print head mounting framework and requires additional frame elements for mounting and springs themselves. The complex assembly of multiple pieces is subject to requiring periodic adjustment, may involve additional manufacturing and maintenance expense, and may also produce a higher degree of unreliability due to the numerous parts and concomitant potential areas for mechanical failure.

Objects of the Invention

In view of the foregoing difficulties with the known prior art, it is an object of this invention to provide an improved reciprocating shuttling printer of reduced cost and complexity.

An additional object of the present invention is to provide improved reciprocable driving means to provide a pure linear velocity in direct axial alignment with the motion of the shuttle framework along the printing line.

Still a further object of this invention is to provide a compact, low cost printer of modular form that can be added in replication to a given terminal or printing application where one or more printing stations may be required for the same machine.

Summary

The dot printer according to the invention comprises

an elongated printing element support member,

one or more dot printing elements mounted on said support member orthogonally thereto,

a platen arranged adjacent to and parallel with said support member,

a suspension spring and frame element essentially composed of two identical parallel E-shaped plate spring elements having each a style and three legs, said support member being rigidly mounted between the free ends of the first (upper) pair of legs, the free ends of the second (central) pair of legs being connected to a frame piece which is rigidly affixed to the frame of said printer, said support member and the free ends of the third (lower) pair of legs being connected together through a connector bar, and said styles of both E-shaped element being connected together through braces, and

drive means causing a linear speed reciprocation movement of said printing element support member in a direction parallel to said platen, without orthogonal or off-axis forces.

According to a specific aspect of the invention, the various part of the suspension spring and frame element and the printing element support member are molded as one piece plastic element.

According to another aspect of the invention the drive means comprise a fixed field magnet and a coil suspended in the field of the magnet and moving thereto upon application of electrical current to the coil, and electronic control means connected to said coil to modify the current in said coil in terms of its displacement, and to move this coil with a linear speed between both ends of its displacement.

According to another aspect of the invention the drive means comprise a uniformly rotating motor, a meshed pair of non circular gears, one of which being coupled to the motor, the other one being coupled to the driving shaft of a crank and rod type mechanism, the geometrical configuration of said non circular gears being such that said driving shaft is rotated at an irregular angular velocity which, when transmitted to said crank and rod type mechanism cause, the free end of said rod to move at a substantially linear velocity.

The invention will now be described with regard to preferred embodiments showing the best modes contemplated for utilizing the invention as shown in the accompanying drawings as follows.

Brief description of the drawings

Figure 1 illustrates a pictorial view of the one-piece molded plastic print head suspension, compound cantilever spring and head mounting frame element.

Figure 2 illustrates an exploded schematic view of the major components for the printer utilizing the one-piece molded suspension and spring assembly of the present invention as well as the voice coil driver assembly of the present invention and other elements of the preferred embodiment.

Figure 3 illustrates a schematic cross-sectional view taken toward the edge of the paper in a printer constructed according to the general scheme shown in Figure 2.

Figure 4 illustrates the emitter output, velocity of the print head and direction of travel for several half cycles of operation.

Figure 5 illustrates the air moving function of the vanes of the rear of the E-spring assemblies which are integrally molded with the device shown in Figure 1.

Figure 6 illustrates an electrical flow chart and schematic diagram for the control and feedback of the voice coil linear driver mechanism shown in Figure 2.

Figure 7 illustrates the detail of the voice coil winding employed in the preferred embodiment.

Figure 8 is a force and displacement chart for operation of the mechanism shown in Figure 2 over a complete cycle of oscillation from left to right and back.

Figure 9 is a force and displacement chart for the forces to be generated by the drive means to drive the carrier assembly as shown in Figure 2.

Figure 10 illustrates an alternative reciprocating drive mechanism utilizing noncircular gears to provide an irregular angular velocity and provide abrupt transitions in direction with a smooth and linear velocity profile intermediate the transitions.

Figure 11 is a comparison of the velocity output profile developed by a mechanism depicted in Figure 7 as contrasted with normal circular gearing output results.

Figures 12 and 13 schematically illustrate the nomenclature and measurement conventions adopted for describing the noncircular gear set values in connection with Appendix Table I.

Detailed specification

The print head suspension framework and mounting system which is depicted in Figure 1 is an integrally molded single piece of plastic. The design was originated to obtain the lowest possible parts cost. It requires, due to the flexing of the E-shaped cantilever spring members, a relatively low tensile modulus in order to keep the spring rate as low as possible since the spring loads will be reflected as loads on the moving voice coil driver system. However, creep modulus of the selected material must be sufficiently high so as to minimize cold flow problems. A number of materials were surveyed and parts were modeled. The most effective material is a polysulfone having a creep modulus of 22,750 kg/cm^2 at 5°C and 280 kg/cm^2 load, a tensile modulus of 24780 kg/cm^2 and a specific gravity of 1.37. Other suitable materials are a polyester and copolymers of engineering structural polymer. In general, the desired materials must have 1.1 to 1.4 specific gravity, 23800 kg/cm^2 minimum tensile modulus and a creep modulus of 22400 kg/cm^2 minimum at 50°C and 105 kg/cm^2 load.

Turning to Figure 1, the one-piece molded print element shuttle suspension and frame member 1 is seen to comprise two relatively E-shaped cantilever spring elements at the ends 2 and 3 respectively.

The molded E-shaped spring members are made such that each member 2 and 3 has first, second and third legs numbered 11, 12 and 13, respectively. Legs 12 are made twice the width of legs 11 and 13 so that the spring rate of the outer leaves 11 and 13 exactly equals that of the center leaf 12. The outer ends forming the bar or stile of the E-shape on each of the spring suspension members 2 and 3 connected together through braces 10a and 10b, the styles and the braces being formed together in a common piece 10. As will be seen later, when the suspension elements of the molded spring assembly are operated in flexure, the end pieces 10 can be utilized to provide a fanning and cooling action for electronic components necessary for the operation of the printer.

Print head carrier frame 7 and aligning member 8 are integrally molded with the spring suspension system. A connector bar 6 connecting the upper framework elements 7 and 8 to the lower framework elements 4 and 5 assures that elements 4, 5, 7 and 8 will move together in reciprocation. Framework element 5 is not visible on the figure because it connects both legs of element 4 and is hidden behind connector bar 6. The oscillatory drive means applies reciprocating forces along the lines EE in Figure 1. This means will be described in greater detail below.

Elements 7 and 8 are shown with alignment holes for accepting wire matrix print heads. It is equally advantageous to employ ink jet dot printers, thermo electric printers, and the like. The holes shown in members 7 and 8 are therefore only indicative of the relative position of a plurality of dot forming heads which may be carried by members 7 and 8.

The frame piece 9 is integrally molded with the E-spring elements and is affixed to the center legs 12 of each E-shaped spring end piece 2 and 3, respectively. Frame piece 9 is affixed to rigid framework in the

printing machine mechanism not shown. Thus the center legs 12 are rigidly anchored by the attachment frame members 9 to a mechanical ground.

The element 5 may have attached to it an optical apertured grid strip to serve as a timing emitter of the well known sort normally employed in wire matrix or dot matrix printers to give appropriate timing pulses for use in electronic control system for synchronizing the firing of the dot matrix solenoids or the like to construct the desired characters.

Turning to Figure 2, the overall major component of a preferred embodiment of a dot matrix printer mechanism utilizing the integrally molded spring framework suspension and carrier assembly 1 are shown. A linear voice coil actuator 14 having a movable armature or coil 15 and a driving bulkhead 16 as utilized in the preferred embodiment are also shown together with other elements in the preferred design. A roller member not shown in Figure 2 is affixed to the bottom of the frame member 5 or 4 to interact with the cam member 17 at each end of oscillatory stroke. This action rocks the cam member 17 in a clockwise or counter clockwise direction depending upon the direction of motion of member 4. A oneway clutch 18 torqued by cam 17 provides a unidirectional rotary motion output on shaft 19 for the purpose of incrementing a paper feed roller 20 and driving a ribbon drive spindle 21.

An individual print element 22 is shown positioned coaxially in line with a set of the apertures in the frame member 7 and 8, it being understood that one or more such print heads 22 may be employed and that they may be of any of a variety of types. An emitter aperture grid 23 containing numerous apertures or slots 24 may be affixed to member 4 or 5 for oscillation back and forth with the carrier and suspension. The emitter grid 23 may pass between the typical photo source and sensor mounting block 25. This block contains a light emitting diode and a photo sensor on opposite sides of a slot through which the emitter grid 23 reciprocates in a well known fashion.

A fixed platen 26 is shown positioned adjacent the printing area where the print head 22 will be reciprocated. Paper feed roll 20 can, through a normal friction feeding engagement with a paper supply 2, cause the paper to increment by one dot height. It is necessary to feed the paper supply at the end of each reciprocating stroke of the carrier to begin printing a new dot. This is done by means of cam member 17, one way clutch 18, etc.

Turning to Figure 3, a schematic cross section of the major elements depicted for the assembly in Figure 2 is illustrated. As may be seen, the feed roll 20 is depicted as roll pair 20A and 20B which frictionally grip and drive the paper 27. The cantilever suspension assembly 1 is rigidly affixed by the frame pieces 9 attached to the center leg 12 of each of the E-shaped spring members. The molded framework 7 and 8 are shown together in a mere schematic representation. The print heads 22 would be coplanarly arranged with respect to the printing line on platen 26 as indicated. An overall cover which may incorporate a plastic tearing knife or guide bar 28 is also shown.

Turning to Figure 4, a timing diagram for a preferred embodiment of the printer as schematically illustrated in Figures 2 and 3 is shown.

In Figure 4 line A illustrates a velocity chart versus time. An initial "set up" time between point A and point C during which the one-piece molded carrier and print head assembly is accelerated from 0 to 398 millimeters per second velocity is shown. This time period may be arbitrary, but typically requires approximately 20 milliseconds. From point C to point D on line A, one full cycle of printing consisting of a left to right and a right to left printing stroke is indicated. The elapsed time of 111 milliseconds (H) is arbitrary and of course longer print lines or greater or lower speeds might be employed. The desired printing stroke covers approximately 16.6 millimeters which is sufficient to encompass 10 dot matrix characters of 5 dots of primary width each. As shown by section E in Figure 4, a brief period at the end of each printing stroke left to right or right to left is allowed for paper feeding time, approximately 13.6 milliseconds as shown. The left to right and right to left print strokes are indicated in sections F and G, respectively, and are truncated to show only a few of the 50 emitter pulses on line B which would be desired. Between the times labeled T_1 and T_{50}, these emitter pulses would be produced by the aperture emitter 23 shown in Figure 2. Each emitter pulse has a total duration I which corresponds to a distance of approximately .339 millimeters of lateral travel. Wire firing for wire matrix print heads can be easily timed to the rising or falling edge of such pulses produced by an emitter.

Turning to Figure 5, a plan view of a portion of the integrally molded spring and suspension means 1 is shown. Only the leaves of the E shaped spring members 11, 12 and 13 and the connecting end pieces 10 are indicated. The rest position is identified as position A in which only the top most leaf 11 of the E-shaped member is visible. On a printing stroke to the right (to position B for element 10) the center leaf 12 becomes exposed as leaves 11 and 13 flex to the left (equivalent to the print head carrier 7, 8 moving toward the right in Figure 1 and 2). In the opposite direction of travel from the rest position A, printing is also accomplished. The left is indicated by the position of element 10 indicated by a letter C. This back and forth motion of the leaves 11, 13 and the common connector members 10 produces a significant air flow shown generally by the arrows in Figure 5 which may be directed or channeled to impinge upon a circuitboard 29 carrying electronic component 30 schematically shown as resistances. As is well known in the printer field, electronic circuit boards 29 typically require small cooling fans or other source of air flow to provide adequate cooling and stable operation of sensitive electronic components. By adding a fan shaped flap 10 as the common connector illustrated in Figures 1 and 2, etc., the integrally molded spring and suspension carrier assembly also serves as a fan to provide this cooling flow of air.

The linear voice coil driving assembly 14, 15 and 16 indicated in Figure 2 can be driven electronically using power drive amplifiers similar to those employed in the audio or high fidelity industry. The specific drive coils are mounted in the armature 15 and are supplied with current by the circuit shown schematically in Figure 6. An additional winding is supplied in the armature 16 to provide a back electromotive force (EMF) pick up signal providing feedback for the control of the precise velocity and position of the armature 16. The circuitry of Figure 6 schematically shows the overall drive and feedback control technique.

Separate windings 31 and 32 are schematically illustrated and will be described further with respect to specific figures depicting them later. A waveform generator 33 generates a rising voltage waveform of the proper shape and duration (to be described below) at its output 34. This is summed with the feedback coming on line 35 which provides a small correction to the output signals which are then applied to a power driving amplifier 36 for eventually driving coil 31. As current is applied to coil 31 by the amplifier 36, the fixed pole piece 14 (not shown in Figure 6) interacts with the electromagnetically generated field of the coil 31 to cause the coil to move inward or outward along the pole piece in element 14 in a manner similar to which a voice coil drives an ordinary audio speaker element. Feedback signals are generated by an EMF generated in coil 32 through a load resistor 37. These signals are sensed at an input buffer amplifier and inverted in inverter 39 where they may be at the output compared or summed with the output from the waveform generator in the summer 40. These provide, if any difference or excess exists, a feedback control on line 35 to the summer 41 for modifying the input of power drive amplifier 36 to more accurately control the velocity and position of the moving coil 31. Overall limits on the voltage excursions can be compared in threshold gate 42 and employed to drive an indicator which will be described in further detail below.

The circuit of Figure 6 may be further described as follows. The feedback coil 32 is physically attached to the mounting core of the power drive coil 31 so that the two coils move together in the presence of the same magnetic field. As the power coil 31 moves, an electro motive force will be generated in the feedback coil 32. Under normal operation, this feedback should be identical in amplitude waveform and frequency to that of the drive coil signal coming from the power drive amplifier 36. Should any aberration of motion occur during the operation of the printer such as by means of a paper jam or intrusion of a foreign object, the signal produced by the feedback coil will be different from that provided to the power amplifier 36. The circuit in Figure 6 processes the feedback signal to detect or correct for these conditions.

The feedback signal is sent to an inverting amplifier 39 through a buffer amplifier 38 to avoid any distortion interaction from the feedback coil 32 modifying the operation of the drive coil 31. From the inverting amplifier 39 the signal is summed with the original driving signal in the summer 40 to yield a correction signal. In normal operation the correction signal will be very small and will be centered about 0. The small signals are fed back into the drive amplifier 36 through summer 41. The resulting motion of the drive coil 31 will be one that better tracks the input waveform. If there is a malfunction such that the motion of the drive coil 31 is impeded and differs significantly from the original driving signal, this will be detected by a threshold gate 42 detecting a level of feedback beyond set limits which may be chosen as desired. This event can be used to shut off power and illuminate a light or LED to notify the user that a regular operating condition has occurred. A reset button or switch can be installed if desired to reset and resume operation.

Details for the drive coil 31 and the feedback coil 32 in the preferred embodiment are as follows. The drive coil consists of 240 turns in two layers of 120 turns each of close wound enamel insulated #31 gauge magnet wire and exhibits a total resistance of approximately 6.6 ohms. The feedback winding for coil 32 is one layer of 40 turns of #38 gauge enamel insulated magnet wire wound on a .76 mm pitch on the outer layer of the inner drive coil but insulated therefrom by a single layer of insulating tape between windings. This latter winding exhibits 3.6 ohm resistance. The return leg of the winding is brought back inside of the turns of the winding coil to hold it securely in place in the same manner that voice coils are wound on bobbins. The coil is shown schematically in Figure 7.

In Figure 7 the moving armature 15 and the driving cross head 16 are attached to a bobbin core 43 which may be of non-magnetic metal, cardboard, plastic or the like. In the preferred embodiment, this bobbin is made of aluminum for strength and is machined to a smooth finish for a close but non-frictional fit into the aperture of the driving pole piece 14.

Figure 8 illustrates the spring loading forces moving right and left including the forces occasioned by the cam paper incrementer mechanism 17 and 18, etc. These forces must be supplied by the driving coil and result in the total force shown in Figure 9 for one complete cycle from right to left and back to the right again. As may be understood, when the spring carrier suspension mechanism is deflected to the right or left of center, energy stored in the spring is released so that for at least a portion of the return stroke, the coil need not supply as much force. However, after crossing the center or 0 force position, additional energy must be supplied to deflect the spring in the opposite direction. When those forces are operated at or near the natural period of vibration for the spring suspension system, some efficiency in operation results.

If the frequency of oscillation of current reversal applied to the driving coil is adjusted to be at or approximately the same as the natural period of vibration of the spring and carrier mass suspension system, very small additional forces are required in order to keep the system in motion. These are chiefly those forces which are extracted by the paper incrementing mechanism near each end of the travel from left to right or right to left. Frictional losses are minimum since there are no bearings, pivots, slides, etc.

Frictional losses due to air motion are the primary source of loss other than the direct mechanical loss due to extraction of force by the paper incrementing mechanism previously described.

Figure 10 illustrates an alternative mechanical gear and reciprocating crank mechanism to replace the voice coil driver. A motor 44 supplies a continuous uniform velocity output through the matched circular gear set 45 to shaft 46 carrying the first of a noncircular gear set 47A and 47B. The constant angular velocity output at shaft A is converted into an irregular angular velocity output by the non-circular gear set 47A and 47B to provide an irregular angular velocity output on shaft B labeled 48. The one to one circular gear set 49 applies this irregular velocity to a matched circular gear set 50 throught he shaft. In the circular gear set 50, each gear is supplied with a driving pin 51 connected to or journalled in individual arms of a flexible plastic connecting rod 52 like a conventional crank and rod mechanism. This rod 52 provides a direct linear output with no component of force orthogonal to the direction of travel at its output point 53.

A helical thread mounted on a drum 54 operates with fixed interposer poins attached to an incrementing wheel (not shown) to increment the wheel by one thread pitch length on the helix 54 with each rotation of the shaft. Each full rotation of the shaft 51 provides an increment at the beginning of a rotation (end of the previous rotation) and another increment halfway through a revolution. Thus, the helical thread is configured to present a cam surface which is not sloped for approximately one-half of a revolution and then it is stepped upward by the distance equal to a given dot row height representing the end of one left to right or right to left stroke at the output 53. This will increment the paper by one dot height. Then, with continued rotation of shaft the shaft, further increment will occur at the end of the return stroke. These details of the helical thread path on drum 54 would be obvious to one of ordinary skill in the art and are not described further.

The flexing drive coupling member 52 can be molded of plastic to reduce cost as is done in the preferred embodiment. The non-circular gear set 47A and 47B is utilized to better control the output motion at point 53. The velocity profile obtained differs substantially from that that would be obtained with normal circular gearing. Figure 11 illustrates the difference.

In Figure 11, the upper curves illustrate the tracing obtained of velocity and time given a normal circular gear set with an input drive rotating at 540 RPM which yields approximately nine cycles per second or 111 milliseconds per cycle. The velocity labeled V1 is slightly greater than that at V2 from the effect of the crank pin and angular thrust output being different at one end of the throw from the other as is well known in the mechanical arts.

The lower portion of Figure 11 illustrates the velocity profile versus time that may be obtained with the noncircular gearing shown in Figure 10. Initial high velocity acceleration rates followed by a flat sustained velocity and an abrupt but smooth transition to the opposite direction are shown. The velocity profiles can be designed so that the maximum V1 and V2 velocities are equal and that the velocity is maintained at a very steady rate over the interval of a print line which is most desirable.

The non-circular gear set comprises two identical gear of non-circular form. They are so designed that the sum of radii measured from each gear center to their common mesh point is constant. In the case illustrated, the constant is 30 mm. This can be verified in Appendex Table I by adding the radii R1 and R2 at each degree of rotation measured as R for gear 1 in the Table. A full set of radius values for each gear in one-degree increments for 0 through 360 is listed in the Table. For gear 1, r is zero when the longest diameter is horizontal in the small Figure 12. Since each gear will rotate by an amount that will produce an equal peripheral travel and R1 does not equal R2, it follows as shown in Figure 13, that r_1 does not equal r_2 for most gear positions. The starting position is shown in Figure 12 with gear 1 set with its longest axis horizontal and defined as 0 degree rotation for purposes of this description. Also for purposes of description, gear 1 in Figure 12 is assumed to rotate counter clockwise. Gear 2 will be engaged with a slight amount of pre-rotation in the clockwise direction as shown in Figure 12 and in the first entry in Table I as 1.49198681 degrees of rotation (measured in this case relative to the gear's shortest axis positioned horizontally). The other table entries follow the same format under each degree of rotation for gear 1. The entries are: degree of rotation r_1, gear designation (gear 1), R1 (tangent radius for gear 1), r_2 degree of rotation for gear 2, and R2 (tangent radius for gear 2). Further details of the non-circular gear set employed in the preferred embodiment are given below in the Appendix, Table I which shows the radius of the gears as a function of angular rotation for one full 360° arc. These gears can be of molded plastic for quiet operation and low cost manufacture. This arrangement has the result of achieving a flat velocity profile across the print line distance. This is of interest in providing high forces for the incrementing function without the limitation of requiring these forces to be extracted from the maximum ends of travel of a voice coil as disclosed above where the force available requires higher currents at these points.

The flexing V-shaped coupling element 52 provides the unique result of counter balancing orthogonal forces. The two counter rotating gears provide orthogonal forces that directly cancel in the V flex coupling 52. Only the resultant straight linear thrust along the axis of symmetry midway between the two shafts of the output gears are produced along the line shown at the output coupling 53.

This mechanical design for the drive mechanism has the additional advantage in that the motor 44 can supply at its output pulley a continuous rotary drive for driving printing ribbon and the like without the necessity of the more complex stepwise camming and incrementing arrangement necessary with the above disclosed voice coil prime driver designs. However, the voice coil design is easily constructed with a minimum of mechanical cost and complexity and provides a basically electronically controlled mechanism.

Either drive may be satisfactorily employed provided that appropriate spacings in the emitter grid are used to adjust the aforementioned velocity profile differences. It will be understood that the non-constant velocity output of the voice coil is not a detriment in such operations since actual wire firing timings for printing the dots are derived from a physical displacement registered by the emitter grid.

APPENDIX—TABLE I

θ_1	Gear	R_1	θ_2	R_2
0.	1.	17.96141301	1.49198681	12.03858699
1.	1.	17.96141301	2.983973621	12.03858699
2.	1.	17.96141301	4.475960431	12.03858699
3.	1.	17.96141301	5.967947241	12.03858699
4.	1.	17.96141301	7.459934052	12.03858699
6.	1.	17.96141301	8.951920862	12.03858699
6.	1.	17.96141301	10.44390767	12.03858699
7.	1.	17.96141301	11.93589448	12.03858699
8.	1.	17.96141301	13.42788129	12.03858699
9.	1.	17.96141301	14.9198681	12.03858699
10.	1.	17.96141301	16.41185491	12.03858699
11.	1.	17.96141301	17.90384172	12.03858699
12.	1.	17.96141301	19.39582853	12.03858699
13.	1.	17.96141301	20.88781534	12.03858699
14.	1.	17.96141301	22.37980215	12.03858699
15.	1.	17.96141301	23.87178897	12.03858699
16.	1.	17.96141301	25.36377578	12.03858699
17.	1.	17.96141301	26.85576259	12.03858699
18.	1.	17.96141301	28.3477494	12.03858699
19.	1.	17.96141301	29.83973621	12.03858699
20.	1.	17.96141301	31.33172302	12.03858699
21.	1.	17.96141301	32.82370983	12.03858699
22.	1.	17.96141301	34.31569664	12.03858699
23.	1.	17.96141301	35.80768345	12.03858699

APPENDIX—TABLE I (contd.)

24.	32.	40.
1.	1.	1.
17.96141301	17.85083341	17.24136579
37.29967026	49.17869283	60.48561194
12.03858699	12.14906659	12.75863421
25.	33.	41.
1.	1.	1.
17.96141301	17.80918199	17.09909739
38.79165707	50.63956133	61.81103063
12.03858699	12.19081801	12.90090261
26.	34.	42.
1.	1.	1.
17.96141301	17.75966524	16.92919857
40.28364388	52.09047469	63.10622272
12.03858699	12.24033476	13.07080143
27.	35.	43.
1.	1.	1.
17.95843948	17.70168353	16.72078763
41.77501532	53.52983286	64.36539285
12.04156052	12.29831647	13.27921237
28.	36.	44.
1.	1.	1.
17.9494876	16.63433785	16.45263075
43.26453602	54.95590603	65.57994493
12.0505124	12.36566215	13.54736925
29.	37.	45.
1.	1.	1.
17.93446227	17.55646252	16.06998424
44.75095649	56.36679603	66.73346776
12.06553773	12.44353748	13.93001576
30.	38.	46.
1.	1.	1.
17.91320062	17.46652229	15.
46.23300314	57.76038548	67.73346776
12.08679938	12.53347771	15.
31.	39.	47.
1.	1.	1.
17.88546522	17.36244872	14.4133724
47.70936733	59.13426308	68.65819457
12.11453478	12.63755128	15.5866276

APPENDIX—TABLE I (contd.)

48.	56.	64.
1.	1.	1.
14.16097317	13.073753	12.43185749
69.55225033	76.08600759	81.9545062
15.83902683	16.926247	17.66814251
49.	57.	65.
1.	1.	1.
13.96468522	12.97903913	12.36680428
70.42312099	76.84854029	82.65584273
16.03531478	17.02096087	17.63319572
50.	58.	66.
1.	1.	1.
13.79797032	12.88923623	12.30447502
71.27474086	77.60182263	83.35118661
16.20202968	17.11076377	17.69552498
51.	59.	67.
1.	1.	1.
13.65052384	12.80386124	12.24474567
72.10966203	78.34640032	84.04082729
16.34947616	17.19613876	17.75625433
52.	60.	68.
1.	1.	1.
13.51705096	12.72252338	12.18760757
72.92972469	79.08276499	84.72603853
16.48294904	17.27747664	17.81249243
53.	61.	69.
1.	1.	1.
13.39440198	12.64490138	12.13266505
73.73634436	79.81136364	85.40408021
16.60559802	17.35509862	17.86733405
64.	62.	70.
1.	1.	1.
13.28052285	12.57072777	12.08013344
74.53065884	80.5326059	86.07819982
16.71947715	17.42927223	17.91986656
55.	63.	71.
1.	1.	1.
13.17398623	12.49977709	12.02983756
75.31361233	81.24686978	86.74763381
16.82601377	17.50022291	17.97016244

APPENDIX—TABLE I (contd.)

72.	80.	88.
1.	1.	1.
11.98171033	11.66869145	11.47169612
87.4126087	92.59647382	97.60391364
18.01828967	18.33130855	18.52830388
73.	81.	89.
1.	1.	1.
11.93569176	11.63798904	11.4546893
88.0733421	93.2302818	98.22157325
18.06430824	18.36201096	18.5453107
74.	82.	90.
1.	1.	1.
11.89172804	11.60906212	11.43933211
88.73004353	93.86151998	98.8378944
18.10827196	18.39093788	18.56066789
75.	83.	91.
1.	1.	1.
11.84977073	11.58188883	11.42561526
89.38291521	94.4903515	99.45302192
18.15022927	18.41811117	18.57438474
76.	84.	92.
1.	1.	1.
11.80977619	11.55644937	11.41353062
90.03215275	95.11693635	100.0670993
18.19022381	18.44355063	18.58646938
77.	85.	93.
1.	1.	1.
11.77170501	11.5327258	11.40307112
90.67794574	95.74143164	100.6802689
18.22829499	18.4672742	18.59692888
78.	86.	94.
1.	1.	1.
11.73552151	11.5107019	11.39423074
91.32047826	96.36399188	101.292672
18.26447849	18.4892981	18.60576926
79.	87.	95.
1.	1.	1.
11.70119342	11.49036306	11.38700445
91.95992944	96.98476922	101.9044491
18.29880658	18.50963694	18.61299555

APPENDIX—TABLE I (contd.)

96.	104.	112.
1.	1.	1.
11.38138817	11.39423074	11.5107019
102.51574	107.4052378	112.3440751
18.61861183	18.60576926	18.4892981
97.	105.	113.
1.	1.	1.
11.37737876	11.40307112	11.5327258
103.126684	108.0184074	112.9885704
18.62262124	18.59692888	18.4672742
98.	106.	114.
1.	1.	1.
11.37497401	11.41353062	11.55644937
103.73742	108.6324848	113.5951552
18.62502599	18.58646938	18.44355063
99.	107.	115.
1.	1.	1.
11.37417257	11.42561526	11.58188883
104.3480867	109.2476123	114.2239867
18.62582743	18.57438474	18.41811117
100.	108.	116.
1.	1.	1.
11.37497401	11.43933211	11.60906212
104.9588227	109.8639335	114.8552249
18.62502599	18.56066789	18.39093788
101.	109.	117.
1.	1.	1.
11.37737876	11.4546893	11.63798904
105.5697667	110.4815931	115.4890329
18.62262124	18.5453107	18.36201096
102.	110.	118.
1.	1.	1.
11.38138817	11.47169612	11.66869145
106.1810576	111.1007375	116.1255773
18.61861183	18.52830388	18.33130855
103.	111.	119.
1.	1.	1.
11.38700445	11.49036306	11.70119342
106.7928347	111.7215148	116.7660285
18.61299555	18.50963694	18.29880658

APPENDIX—TABLE I (contd.)

120.	128.	136.
1.	1.	1.
11.73552151	12.08013344	12.57072777
117.407561	122.6814265	128.2741431
18.26447849	17.91986656	17.42927223
121.	129.	137.
1.	1.	1.
11.77170501	12.13266505	12.64490138
118.053354	123.3604682	129.0027417
18.22829499	17.86733495	17.35509862
122.	130.	138.
1.	1.	1.
11.80977619	12.18750757	12.72252336
118.7025915	124.0446794	129.7391064
18.19022381	17.81249243	17.27747664
123.	131.	139.
1.	1.	1.
11.84977073	12.24474567	12.80386124
119.3564632	124.7343201	130.4836841
18.15022927	17.75525433	17.19613876
124.	132.	140.
1.	1.	1.
11.89172804	12.30447502	12.88923623
120.0121646	125.429684	131.2369664
18.10827196	17.69552498	17.11076377
125.	133.	141.
1.	1.	1.
11.93569176	12.36680428	12.97903913
120.672898	126.1310006	131.9904091
18.06430824	17.63319572	17.02096087
126.	134.	142.
1.	1.	1.
11.98171033	12.43185749	13.073753
121.3378729	126.8386369	132.7718944
18.01828967	17.56814251	16.926247
127.	135.	143.
1.	1.	1.
12.02983756	12.49977709	13.17398623
122.0073069	127.5528008	133.5548478
17.97010244	17.50022291	16.82601377

APPENDIX—TABLE I (contd.)

144.	152.	160.
1.	1.	1.
13.28052285	15.	17.46652229
134.3491624	141.352039	151.7187107
16.71947715	15.	12.53347771
145.	153.	161.
1.	1.	1.
13.39440198	16.06998424	17.55646252
135.155782	142.5056618	153.1296007
16.60559802	13.93001576	12.44353748
146.	154.	162.
1.	1.	1.
13.51705096	16.45263075	17.63433785
135.9758447	143.7201139	154.5556738
16.48294904	13.54736925	12.36566215
147.	155.	163.
1.	1.	1.
13.65052384	16.72078763	17.70168353
136.8107659	144.979284	155.995032
16.34947616	13.27921237	12.29831647
148.	156.	164.
1.	1.	1.
13.79797032	16.92919857	17.75966524
137.6623857	146.2744761	157.4459454
16.20202968	13.07080143	12.24033476
149.	157.	165.
1.	1.	1.
13.96468522	17.09909739	17.80918199
138.5332564	147.5996948	158.9068139
16.03531478	12.90090261	12.19081801
150.	158.	166.
1.	1.	1.
14.16097317	17.24136579	17.85093341
139.4273121	148.9512436	160.3781394
15.83902683	12.75863421	12.14906659
151.	159.	167.
1.	1.	1.
14.4133724	17.36244872	17.88546522
140.352039	150.3251212	161.8525036
15.5866276	12.63755128	12.11453478

APPENDIX—TABLE I (contd.)

168.	176.	184.
1.	1.	1.
17.91320062	17.96141301	17.96141301
163.3345502	175.2617969	187.1976814
12.08679938	12.03858699	12.03858699
169.	177.	185.
1.	1.	1.
17.93446227	17.96141301	17.96141301
164.8209707	176.7537837	188.6896782
12.06553773	12.03858699	12.03858699
170.	178.	186.
1.	1.	1.
17.9494876	17.96141301	17.96141301
166.3104914	178.2457705	190.181665
12.0505124	12.03858699	12.03858699
171.	179.	187.
1.	1.	1.
17.95843948	17.96141301	17.96141301
167.8018628	179.7377573	191.6736518
12.04156052	12.03858699	12.03858699
172.	180.	188.
1.	1.	1.
17.96141301	17.96141301	17.96141301
169.2938496	181.2297441	193.1656386
12.03858699	12.03858699	12.03858699
173.	181.	189.
1.	1.	1.
17.96141301	17.96141301	17.96141301
170.7858365	182.7217309	194.6576254
12.03858699	12.03858699	12.03858699
174.	182.	190.
1.	1.	1.
17.96141301	17.96141301	17.96141301
172.2778233	184.2137178	190.1496122
12.03858699	12.03858699	12.03858699
175.	183.	191.
1.	1.	1.
17.96141301	17.96141301	17.96141301
173.7698101	185.7057046	197.641599
12.03858699	12.03858699	12.03858699

APPENDIX—TABLE I (contd.)

192.	200.	208.
1.	1.	1.
17.96141301	17.96141301	17.96141301
199.1335859	211.0694803	223.0053748
12.03858699	12.03858699	12.03858699
193.	201.	209.
1.	1.	1.
17.96141301	17.96141301	17.96141301
200.6255727	212.5614671	224.4973616
12.03858699	12.03858699	12.03858699
194.	202.	210.
1.	1.	1.
17.96141301	17.96141301	17.96141301
202.1175595	214.053454	225.9893484
12.03858699	12.03858699	12.03858699
195.	203.	211.
1.	1.	1.
17.96141301	17.96141301	17.96141301
203.6095463	215.5454408	227.4813352
12.03858699	12.03858699	12.03858699
196.	204.	212.
1.	1.	1.
17.96141301	17.96141301	17.96141301
205.1015331	217.0374276	228.9733221
12.03858699	12.03858699	12.03858699
197.	205.	213.
1.	1.	1.
17.96141301	17.96141301	17.96141301
206.5935199	218.5294144	230.4653089
12.03858699	12.03858699	12.03858699
198.	206.	214.
1.	1.	1.
17.96141301	17.96141301	17.96141301
208.0855067	220.0214012	231.9572957
12.03858699	12.03858699	12.03858699
199.	207.	215.
1.	1.	1.
17.96141301	17.96141301	17.96141301
209.5774935	221.513388	233.4492825
12.03858699	12.03858699	12.03858699

APPENDIX—TABLE I (contd.)

216.	224.	232.
1.	1.	1.
17.96141301	17.91320062	17.46652229
234.9412693	246.8585768	258.3859581
12.03858699	12.08679938	12.53347771
217.	225.	233.
1.	1.	1.
17.96141301	17.88546522	17.36244872
236.4332561	248.33494	259.7598357
12.03858699	12.11453478	12.63755128
218.	226.	234.
1.	1.	1.
17.96141301	17.85093341	17.24136579
237.9252429	249.8042656	261.1111846
12.03858699	12.14906659	12.75863421
219.	227.	235.
1.	1.	1.
17.90141301	17.80918199	17.09909739
239.4172297	251.265134	282.4366033
12.03858699	12.19081801	12.90090261
220.	228.	236.
1.	1.	1.
17.86141301	17.75966524	16.92919857
240.9092165	252.7180473	263.7317954
12.03858699	12.24033476	13.07080143
221.	229.	237.
1.	1.	1.
17.95843948	17.70168353	16.72078763
242.400588	254.1554058	264.9309655
12.04156052	12.29831647	13.27921237
222.	230.	238.
1.	1.	1.
17.9494876	17.63433785	16.45263075
243.8901087	255.5814787	266.2054176
12.0505124	12.36566215	13.54736925
223.	231.	239.
1.	1.	1.
17.93446227	17.55646252	16.06998424
245.3765291	256.9923687	267.3590404
12.06553773	12.44353748	13.93001576

APPENDIX—TABLE I (contd.)

240.	248.	256.
1.	1.	1.
15.	12.94340527	12.08022273
268.3590404	274.9476585	280.608891
15.	17.05659473	17.91977727
241.	249.	257.
1.	1.	1.
14.30598452	12.8140918	11.99392308
269.2705971	275.6931747	281.2749951
15.69401548	17.1859082	18.00607692
242.	250.	258.
1.	1.	1.
14.00473934	12.69230769	11.91136814
270.1461527	276.4205081	281.9334962
15.99526066	17.30769231	18.08863386
243.	251.	259.
1.	1.	1.
13.76945629	12.5771403	11.83236452
270.9945196	277.1483838	282.5847833
16.23054371	17.4228597	18.16763548
244.	252.	260.
1.	1.	1.
13.56897309	12.46788278	11.75675676
271.8203336	277.8595291	283.2292277
16.43102691	17.53211722	18.24324324
246.	253.	261.
1.	1.	1.
13.39119801	12.36397525	11.68440285
272.6266048	278.5605927	283.8671759
16.60880199	17.63602475	18.31559715
246.	254.	262.
1.	1.	1.
13.22992331	12.26496585	11.6151807
273.4155054	279.2521598	284.498957
16.77007669	17.73503415	18.3848193
247.	255.	263.
1.	1.	1.
13.08146	12.1704842	11.51898327
274.188708	279.934763	285.1248837
16.91854	17.8295158	18.45101673

APPENDIX—TABLE I (contd.)

264.	272.	280.
1.	1.	1.
11.48571635	11.07678794	10.82497548
285.7452642	290.5402815	295.1209662
18.51428366	18.92321206	19.17502452
265.	273.	281.
1.	1.	1.
11.42529668	11.03705969	10.80386798
286.360354	291.1223146	295.683781
18.57470332	18.96294031	19.19613202
266.	274.	282.
1.	1.	1.
11.36765042	10.99973729	10.78501326
286.9704569	291.7012402	296.2450624
18.63234958	19.00026271	19.21498674
267.	275.	283.
1.	1.	1.
11.31271187	10.96479338	10.76840067
287.5758263	292.2772672	296.804995
18.68728813	19.03520662	19.23159933
268.	276.	284.
1.	1.	1.
11.26042247	10.93220339	10.75402101
288.1767162	292.8506005	297.3637622
18.73957753	19.0677966	19.24597899
269.	277.	285.
1.	1.	1.
11.21072989	10.9019453	10.74186646
288.7733721	293.4214412	297.9216456
18.78927011	19.0980547	19.25813354
270.	278.	286.
1.	1.	1.
11.16358723	10.87399937	10.73193052
289.3660321	293.9899865	298.4786256
18.83641277	19.12600063	19.26806948
271.	279.	287.
1.	1.	1.
11.11895249	10.84834798	10.72420792
289.954927	294.556431	299.0348819
18.88104751	19.15165202	19.27579208

APPENDIX—TABLE I (contd.)

288.	296.	304.
1.	1.	1.
10.71869464	10.75402101	10.93220339
299.5907931	304.0434357	308.5711635
19.28130536	19.24597899	19.0677966
289.	297.	305.
1.	1.	1.
10.71538781	10.76840067	10.96479338
300.1464376	304.6033684	309.1471906
19.28461219	19.23159933	19.03520662
290.	298.	306.
1.	1.	1.
10.71428572	10.78501326	10.99973729
300.7019932	305.1646497	309.7261161
19.28571428	19.21498674	19.00026271
291.	299.	307.
1.	1.	1.
10.71538781	10.80386798	11.03705969
301.2576376	305.7274646	310.3081492
19.28461219	19.19613202	18.96294031
292.	300.	308.
1.	1.	1.
10.71869464	10.82497548	11.07678794
301.8135489	306.2919997	310.8935038
19.28130536	19.17502452	18.92321206
293.	301.	309.
1.	1.	1.
10.72420792	10.84834798	11.11895249
302.3699051	306.8584442	311.4823987
19.27579208	19.15165202	18.88104751
294.	302.	310.
1.	1.	1.
10.73193052	10.87399937	11.16358723
302.9268852	307.4269896	312.0750586
19.26806948	19.12600063	18.83641277
295.	303.	311.
1.	1.	1.
10.74186646	10.9019453	11.21072989
303.4846686	307.9978302	312.6717146
19.25813354	19.0980547	18.78927011

APPENDIX--TABLE I (contd.)

312.	320.	328.
1.	1.	1.
11.26042247	11.75675676	12.46788278
313.2726044	318.2636475	323.7000469
18.73957753	18.24324324	17.53211722
313.	321.	329.
1.	1.	1.
11.31271187	11.83236452	12.5771403
313.8779738	318.9149356	324.4219227
18.68728813	18.16763548	17.4228597
314.	322.	330.
1.	1.	1.
11.37675042	11.91136614	12.69230769
314.4880767	319.5734356	326.165256
18.63234958	18.08863386	17.30769231
315.	323.	331.
1.	1.	1.
11.42529668	11.99392308	12.8140918
315.1031765	320.2395398	325.9008722
18.57470332	18.00607692	17.1859082
316.	324.	332.
1.	1.	1.
11.48571635	12.08022273	12.94340627
315.7235471	320.9136677	326.6597227
18.51428365	17.91977727	17.05659473
317.	325.	333.
1.	1.	1.
11.54898327	12.1704842	13.08146
316.3494737	321.5962709	327.4329254
18.45101673	17.8295158	16.91854
318.	326.	334.
1.	1.	1.
11.6151807	12.20490685	13.22992331
316.9812548	322.287838	328.221826
18.3848193	17.73503415	16.77007669
319.	327.	335.
1.	1.	1.
11.68440285	12.36397525	13.39119801
317.619203	322.8889016	329.0280971
18.31559715	17.63602475	16.60880199

APPENDIX—TABLE I (contd.)

336.	344.	352.
1.	1.	1.
13.56897309	16.92919857	17.75966524
329.8530112	338.4118276	349.5832968
16.43102691	13.07080143	12.24033476
337.	345.	353.
1.	1.	1.
13.76945629	17.09909739	17.80918199
330.7022781	339.7372461	351.0441663
16.23054371	12.90090261	12.19081801
338.	346.	354.
1.	1.	1.
14.00473934	17.24136579	17.85093341
331.5778337	341.088595	352.5134908
15.99526066	12.75863421	12.14906659
339.	347.	355.
1.	1.	1.
14.30598452	17.36244872	17.88546522
332.4893903	342.4624726	353.9898549
15.69401548	12.63755128	12.11453478
340.	348.	356.
1.	1.	1.
15.	17.46652229	17.91320062
333.4893903	343.8560621	355.4719016
15.	12.53347771	12.08679938
341.	349.	357.
1.	1.	1.
16.06998424	17.55646252	17.93446227
334.6430132	345.2669521	356.9583221
13.93001576	12.44353748	12.06553773
342.	350.	358.
1.	1.	1.
16.45263075	17.63433785	17.9494876
335.8574652	346.6930251	358.4478428
13.54736926	12.36566215	12.0505124
343.	351.	359.
1.	1.	1.
16.72078763	17.70168353	17.95843948
337.1166354	348.1323834	359.9392142
13.27921237	12.29831647	12.04156052

Claims

1. A dot printer comprising:

at least one dot printing element (22);

an elongated support member (7) for said printing element,

a platen (26) arranged adjacent to and parallel with said support member,

a suspension spring and frame element (1) comprising two identical and parallel E-shaped plate spring elements (2, 3) having each a stile (10), a first (upper), a second (central) and a third (lower) legs (11, 12, 13), forming a pair of stiles and three pairs of legs, the ends of said support member (7) being respectively connected to the free ends of one pair of said legs, the free ends of at least one of the remaining pairs of legs being rigidly affixed to the frame of said printer to support the whole suspension element, and

drive means (14—16) for reciprocating said support member in a direction parallel to said platen, characterized in that:

the ends of said support member (7) are respectively rigidly connected to the free ends of the first (upper) pair of legs (11),

the free ends of the second (central) pair of legs (12) are connected to a frame piece (9) which is rigidly affixed to the frame of said printer,

said support member (7) and the free ends (4) of the third (lower) pair of legs (13) are linked together through a connector bar (6),

said stiles (10) of said E-shaped elements are connected together through braces (10a, 10b),

said drive means are designed to cause a linear speed reciprocation movement of said printing element support member without orthogonal or off-axis forces.

2. Dot printer according to claim 1, characterized in that said E-shape plate spring elements (2, 3), said support member (7), said frame piece (9) and said connector bar (6) constitute a unitary molded flexible plastic element.

3. Dot printer according to claim 1 or 2, characterized in that said drive means are arranged to reciprocate both the first (upper) and the third (lower) pairs of legs (11, 13), thus flexing said first and second pair of legs and moving said support member (7) and said dot printing element (22) back and forth along a print line parallel to said platen (26).

4. Dot printer according to claim 1, 2 or 3, characterized in that the combined spring rates of said first and third pairs of legs equals that of said second pair of legs.

5. Dot printer according to any one of the preceding claims characterized in that said drive means comprise:

a fixed field magnet (14),

a winding coil (15) suspended in the field of said magnet and moving with respect thereto upon application of electrical current to said coil, the external end of said coil being connected to said printing element support member for reciprocation thereof, said coil (15) comprising:

a first winding (31) receiving a driving current from a waveform generator (33) and

a second winding (32) including a circuit containing an inverting amplifier (38, 39) sommation means (40, 41) and control means for modifying the driving current applied to said first winding to produce exact tracking between input driving signals to said winding and the resulting physical motion thereof.

6. Dot printer according to any one of the previous claims, characterized in that it further comprises: paper print media drive means (20) for feeding said paper (27) incrementally past said platen (26), incremental cam and clutch means (17, 18), and

an interposer means so affixed to said suspension spring and frame element as to be reciprocated therewith and to interact with said cam and one way clutch means for providing intermittent rotary output, said intermittent rotary output being connected to said paper media drive and incrementing means (20) to increment said paper at the end of each said reciprocation.

7. Dot printer according to any one of claims 1 to 4, characterized in that said drive means comprise:

a uniformly rotating motor (44),

a meshed pair of non-circular gears (47A, 47B), one of which (47A) being coupled to said motor (44), the other one (47B) being coupled to the driving shaft of a crank and rod type mechanism (50, 51, 52), the geometrical configuration of said non-circular gears being such that said driving shaft is rotated at an irregular angular velocity which, when transmitted to said crank and rod type mechanism causes the free end of said rod (52) to move at a substantially linear velocity, said free end being connected to said support member (7) to provide said linear reciprocation movement.

8. Dot printer according to claim 7, characterized in that said driving shaft of said crank and rod mechanism is coupled to the shaft of another identical crank and rod type mechanism arranged symmetrically with respect to the first one, the respective free ends of both rods (52) being connected together and both rods being so mounted that they always form a V, more or less flared according to the angular position of the shafts, but having always the same symmetry axis, which symmetry axis is parallel to the direction of said reciprocating movement.

9. Dot printer according to any one of the preceding claims, characterized in that said stiles (10) of said E-shaped elements are adapted to cause a fanning of air whenever said legs are flexed back and forth by said reciprocation.

10. Dot printer according to any one of claims 2 to 9, characterized in that said unitary molded flexible element is molded integrally of a plastic having a specific gravity of at least 1.06, a tensile modulus of at least 23800 kg/cm² and a creep modulus of at least 22400 kg/cm² at 5°C and 105 kg/cm² load.

Patentansprüche

1. Matrixdrucker mit:

mindestens einem Punktdruckelement (22);

einem länglichen Halteglied (7) für das besagte Druckelement,

einer am besagten Halterungselement anliegenden und parallel zu ihm angeordneten Druckwalze (26),

einer Aufhängungsfeder und einem Rahmenelement (1), mit zwei identischen und parallelen E-förmigen Blattfederelementen (2, 3), von denen jedes eine Stufe (10), ein erstes (oberes), ein zweites (mittleres) und ein drittes (unteres) Bein (11, 12, 13) besitzt, welche ein Paar Stufen und drei Paar Beine bilden, sodass die Enden des besagten Halterungsgliedes (7) an den freien Enden eines Paares der besagten Beine angeschlossen sind, und die freien Enden von mindestens einem der verbleibenden

Beinpaare starr am Rahmen des besagten Druckers befestigt sind, um das ganze Aufhängelement zu tragen,

und Antriebsmittel (14—16), um das besagte Halterungsglied in einer Richtung parallel zur besagten Walze zu bewegen,

dadurch gekennzeichnet, dass:

die Enden des besagten Halterungsgliedes (7) starr an die freien Enden des ersten (oberen) Beinpaares (11) angeschlossen sind,

die freien Enden des zweiten (mittleren) Paars (12) an ein Rahmenteil (9) angeschlossen sind, welches starr am Rahmen des besagten Druckers befestigt ist,

das besagte Halterungsglied (7) und die freien Enden (4) des dritten (unteren) Beinpaares (13) durch eine Verbindungsstange (6) miteinander verbunden sind,

die besagten Stufen (10) der besagten E-förmigen Elemente durch Streben (10a, 10b) miteinander verbunden sind,

die besagten Antriebsmittel ausgelegt sind, um eine Bewegung des besagten Druckelementhalterungsgliedes in linearer Geschwindigkeit in beiden Richtungen ohne rechtwinklige oder von der Achse wegstrebende Kräfte zu erzeugen.

2. Matrixdrucker gemäss Anspruch 1, dadurch gekennzeichnet, dass die besagten E-förmigen Blattfederelemente (2, 3), das besagte Halterungsglied (7), das besagte Rahmenteil (9) und die besagte Anschlusstange (6) ein einziges gegossenes flexibles Plastikbauteil bilden.

3. Matrixdrucker gemäss Anspruch 1 oder 2, dadurch gekennzeichnet, dass die besagten Antriebsmittel so angeordnet sind, dass sie sowohl das erste (obere) als auch das dritte (untere) Beinpaar (11, 13) hin- und herzubewegen, und damit das besagte erste und zweite Beinpaar biegen und das besagte obere Glied (7) und das besagte Matrixdruckelement (22) an einer Druckzeile parallel zur besagten Druckwalze (26) vorwärts und rückwärts bewegen.

4. Matrixdrucker gemäss Anspruch 1, 2 oder 3, dadurch gekennzeichnet, dass die kombinierten Federkräfte des besagten ersten und dritten Beinpaars gleich mit denen des zweiten Beinpaares sind.

5. Matrixdrucker gemäss einem der vorangehenden Ansprüche, dadurch gekennzeichnet, dass das besagte Antriebsmittel enthält:

einen festen Feldmagneten (14),

eine Wicklungsspule (15), im Feld des besagten Magneten aufgehängt, und sich bewegend in Abhängigkeit von dem an der besagten Spule anliegenden elektrischen Strom, wobei das äussere Ende der besagten Spule an das besagte Druckelement-Halteglied angeschlossen ist, um dieses hin- und herzubewegen, enthaltend:

eine erste Wicklung (31), die einen Antriebsstrom aus einem Wechselstromgenerator (33) empfängt, und

eine zweite Spule (32) mit einer Schaltung, die einen Umkehrverstärker (38, 39) mit Summiermitteln (40, 41) und Steuermitteln für die Änderung des Antriebsstromes enthält, der an die besagte erste Wicklung angelegt wird, um eine genaue Entsprechung zwischen den Eingangsantriebssignalen an der besagten Wicklung und den sich daraus ergebenden physikalischen Bewegungen zu erzeugen.

6. Matrixdrucker gemäss einem der vorangehenden Ansprüche, dadurch gekennzeichnet, dass er ausserdem enthält:

Antriebsmittel (20) für Druckmedium Papier für den inkrementalen Vorschub des besagten Papiers (27) über die besagte Druckwalze (26),

inkrementale Nocke und Klammern (17, 18) und

ein dazwischenliegendes Mittel, so an der besagten Aufhängungsfeder und am Rahmenelement befestigt, dass es zusammen mit diesem hin- und herbewegt wird und mit der besagten Nocke und Einwegklammer in Wechselwirkung tritt, um in Abständen eine Drehbewegung zu liefern, wobei die besagte Drehbewegung an dem besagten Papiermediumantrieb angeschlossen wird, und Mittel (20) zum Inkrementieren des besagten Papiers am Ende einer jeden Hin- und Herbewegung.

7. Matrixdrucker gemäss einem der Ansprüche 1 bis 4, dadurch gekennzeichnet, dass der besagte Antrieb enthält:

einen gleichmässig laufenden Motor (44),

ein ineinander eingreifendes Paar von nicht runden Getriebeelementen (47A, 47B), von denen eines (47A) am besagten Motor (44) angekoppelt ist, während das andere (47B) an der Antriebswelle eines Mechanismus vom Typ Kurbelwelle und Stange (50, 51, 52) angekoppelt ist, und die geometrische Konfiguration des besagten nicht-runden Getriebeelementes so ist, dass die besagte Antriebswelle in einer ungleichmässigen Winkelgeschwindigkeit angetrieben wird, die, wenn sie an den besagten Kurbelwellen- und Stangenmechanismus übertragen wird, das freie Ende der besagten Stange (52) in einer wesentlich linearen Geschwindigkeit antreibt, während das besagte freie Ende am besagten Halterungsglied (7) angeschlossen ist, um die besagte lineare Hin- und Herbewegung zu erzeugen.

8. Matrixdrucker gemäss Anspruch 7, dadurch gekennzeichnet, dass die besagte Antriebswelle des besagten Kurbelwellen- und Stangenmechanismus an die Welle eines anderen identischen Kurbelwellen- und Stangenmechanismus angeschlossen ist, der symmetrisch zum ersten angeordnet ist und dass die freien Enden der beiden Stangen (52) miteinander verbunden sind und beide Stangen so montiert sind, dass sie immer ein V bilden, je nach der Winkelposition der Wellen, mehr oder weniger weit geöffnet,

jedoch immer mit der gleichen Symmetrieachse, die parallel zur Richtung der besagten Hin- und Herbewegung verläuft.

9. Matrixdrucker gemäss einem der vorangehenden Ansprüche, dadurch gekennzeichnet, dass die besagten Stufen (10) den besagten E-förmigen Elementen angepasst sind, um eine Belüftung zu bewirken, immer, wenn die besagten Beine durch die besagte Vor- und Rückwärtsbewegung nach vorn und hinten gebogen werden.

10. Matrixdrucker gemäss einem der Ansprüche 2 bis 9, dadurch gekennzeichnet, dass die besagten einheitlich gegossenen flexiblen Elemente vollständig aus Kunststoff mit einem spezifischen Gewicht von mindestens 1,06 gegossen sind, mit einem Spannungsmodul von mindestens 23800 kg/cm² und einem Kreichmodul von mindestens 22400 kg/cm² bei 5°C und einer Belastung von 105 kg/cm².

Revendications

1. Une imprimante par points comprenant:
au moins un élément d'impression par points (22),
un élément de support allongé (7) pour ledit élément d'impression,
une platine (26) disposée dans une position adjacente et parallèle audit élément de support,
un élément à cadre et ressort de suspension (1) comprenant deux éléments flexibles à plaques en forme de E identiques et parallèles (2, 3) présentant chacune un montant (10), une première (supérieure), une deuxième (centrale) et une troisième (inférieure) pattes (11, 12, 13), formant une paire de montants et trois paires de pattes, les extrémités dudit élément de support (7) étant respectivement raccordées aux extrémités libres d'une paire desdites pattes, les extrémités libres d'au moins l'une des paires de pattes restant étant fixées au chassis de ladite imprimante pour supporter l'élément de suspension en entier, et
des moyens d'entraînement (14—16) pour animer ledit élément de support d'un mouvement de va et vient parallèlement à ladite platine,
caractérisée en ce que:
les extrémités dudit élément de support (7) sont respectivement fixées aux extrémités libres de la première (supérieure) pair de pattes (11),
les extrémités libres de la deuxième (centrale) paire de pattes (12) sont raccordées à une partie de chassis (9) qui est fixée au chassis de ladite imprimante,
ledit élément de support (7) et les extrémités libres (4) de la troisième (inférieure) paire de pattes (13) sont reliées par une barre de connexion (6),
lesdits montants (10) desdits éléments en forme de E sont reliés par des tirants (10a, 10b),
lesdits moyens d'entraînement sont conçus un mouvement de va et vient à vitesse linéaire dudit élément de support d'élément d'impression sans application de forces orthogonales ou désaxées.

2. Imprimante par points selon la revendication 1 caractérisée en ce que lesdits éléments flexibles à plaques en forme de E (2, 3), ledit élément de support (7), ladite partie de chassis (9) et ladite barre de connexion (6) constituent un élément en plastique flexible moulée formant une unité.

3. Imprimante par points selon la revendication 1 ou 2 caractérisée en ce que lesdits moyens d'entraînement sont agencés de façon à animer d'un mouvement de va et vient à la fois les première (supérieure) et troisième (inférieure) paires de pattes (11, 13), ce qui provoque ainsi la flexion desdites première et deuxième paires de pattes et le déplacement dudit élément de support (7) et dudit élément d'impression par points (22) suivant un mouvement de va et vient le long d'une ligne d'impression parallèle à ladite platine (26).

4. Imprimante par points selon la revendication 1, 2 ou 3 caractérisée en ce que les constantes de ressort combinées desdites première et troisième paires de pattes sont égales à celle de ladite deuxième paire de pattes.

5. Imprimante par points selon l'une quelconque des revendications précédentes caractérisée en ce que lesdits moyens d'entraînement comprennent:
un aimant de champ fixe (14),
une bobine à enroulement (15) suspendue dans le champ dudit aimant et se déplaçant par rapport à celui ci lors de l'application de courant électrique à ladite bobine, l'extrémité extérieure de ladite bobine étant connectée audit élément de support d'élément d'impression pour animer celui ci d'un mouvement de va et vient, ladite bobine (15) comprenant:
un premier enroulement (31) recevant un courant d'excitation à partir d'un générateur de formes d'ondes (33) et
un second enroulement (32) comprenant un circuit contenant un amplificateur inverseur (38, 39), des moyens de sommation (40, 41) et des moyens de commande pour modifier le courant d'excitation appliqué audit premier enroulement pour obtenir une correspondance exacte entre les signaux d'excitation d'entrée audit enroulement et le mouvement physique résultant de ceux ci.

6. Imprimante par points selon l'une quelconque des revendications précédentes caractérisée en ce qu'elle comprend en outre:
des moyens de commande des milieux d'impression en papier (20) pour alimenter ledit papier (27) par incréments devant ladite platine (26),

des moyens de commande à came et embrayage (17, 18) et

un moyen de commande fixé audit élément du chassis à ressort de suspension pour être animé d'un mouvement de va et vient avec celui ci et fonctionner en association avec ledit moyen à came et à embrayage monodirectionnel pour délivrer une sortie de rotation intermittente, ladite sortie de rotation intermittente étant appliquée auxdits moyens de commande et d'incrémentation du milieu en papier (20) pour incrémenter ledit papier à la fin de chacun desdits mouvements de va et vient.

7. Imprimante par points selon l'une quelconque des revendications 1 à 4 caractérisée en ce que lesdits moyens de commande comprennent:

un moteur à rotation uniforme (44),

un engrenage de deux pignons non circulaires (47A, 47B), dont l'un (47A) est accouplé audit moteur (44), l'autre (47B) étant accouplée à l'arbre d'entraînement d'un mécanisme du type à tiges et manivelles (50, 51, 52), la configuration géométrique desdits pignons non circulaires étant telle que ledit arbre d'entraînement est entraîné en rotation à un vitesse angulaire irrégulière qui, lorsqu'elle est transmise audit mécanisme du type à tiges et manivelles, provoque le déplacement de l'extrémité libre de ladite tige (52) à une vitesse pratiquement linéaire, ladite extrémité libre étant raccordée audit élément de support (7) pour provoquer ledit mouvement de va et vient linéaire.

8. Imprimante par points selon la revendication 7 caractérisé en ce que ledit arbre d'entraînement dudit mécanisme à tiges et manivelles est accouplé à l'arbre d'un autre mécanisme de type identique disposé symétriquement par rapport au premier, les extrémités libres respectives des deux tiges (52) étant reliées et les deux tiges étant montées de façon qu'elles forment toujours un V plus ou moins évasé selon la position angulaire des arbres, mais en conservant toujours le même axe de symétrie, lequel axe de symétrie est parallèle audit mouvement de va et vient.

9. Imprimante par points selon l'une quelconque des revendications précédentes caractérisée en ce que lesdits montants (10) desdits éléments en forme de E sont conçus pour provoquer une ventilation pneumatique chaque fois que les pattes sont fléchies d'avant en arrière et vice versa par ledit mouvement de va et vient.

10. Imprimante par points selon l'une quelconque des revendications 2 à 9, caractérisée en ce que ledit élément flexible moulé en une seule pièce est constitué d'une seule pièce de matière plastique dont le poids spécifique est au moins de 1,06, le module de traction d'au moins 23800 kg/cm² et le module de fluage d'au moins 22400 kg/cm² à 5°C et avec une charge de 105 kg/cm².

0 082 329

FIG. 1

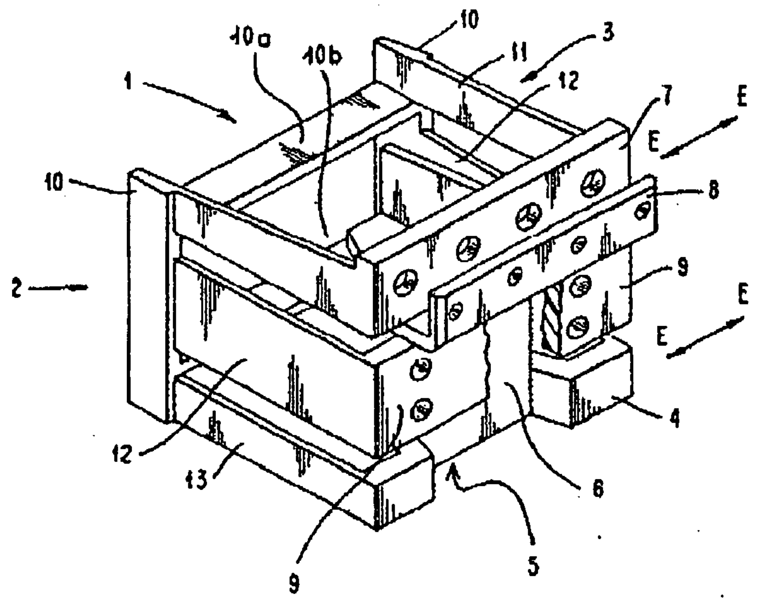


FIG. 3

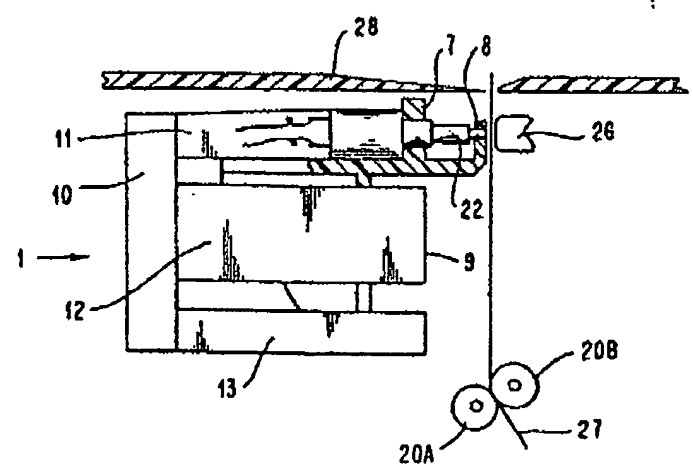
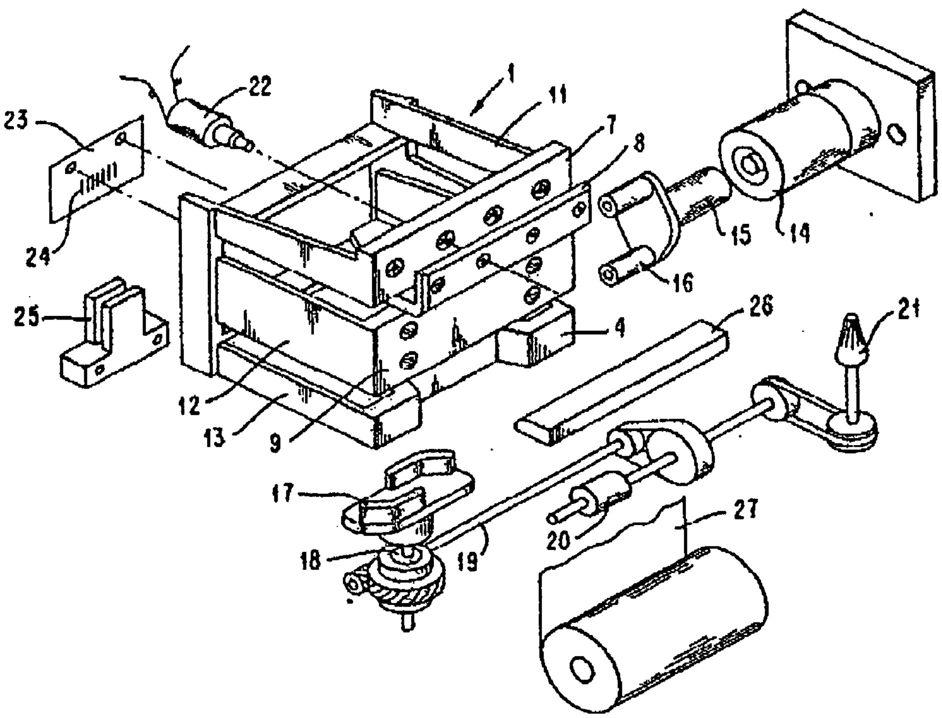
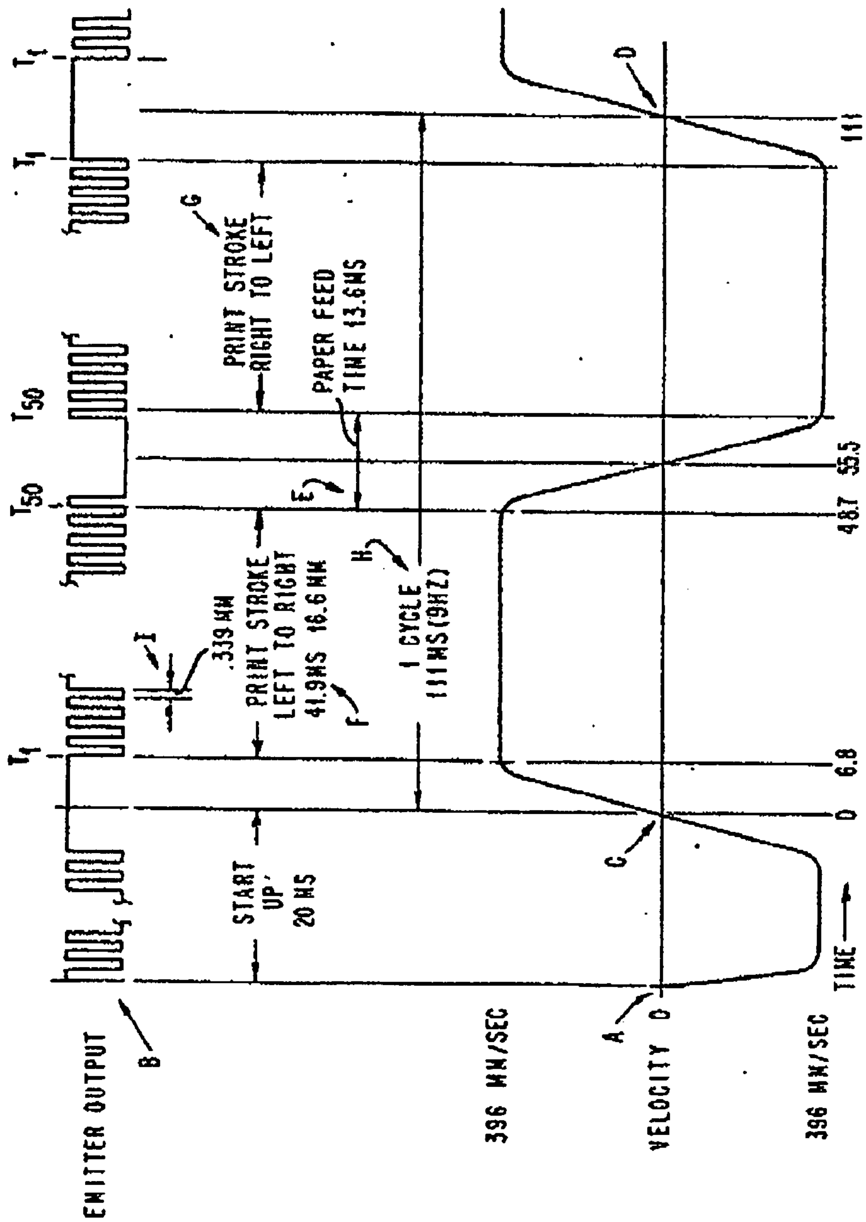


FIG. 2



0 082 329

FIG. 4



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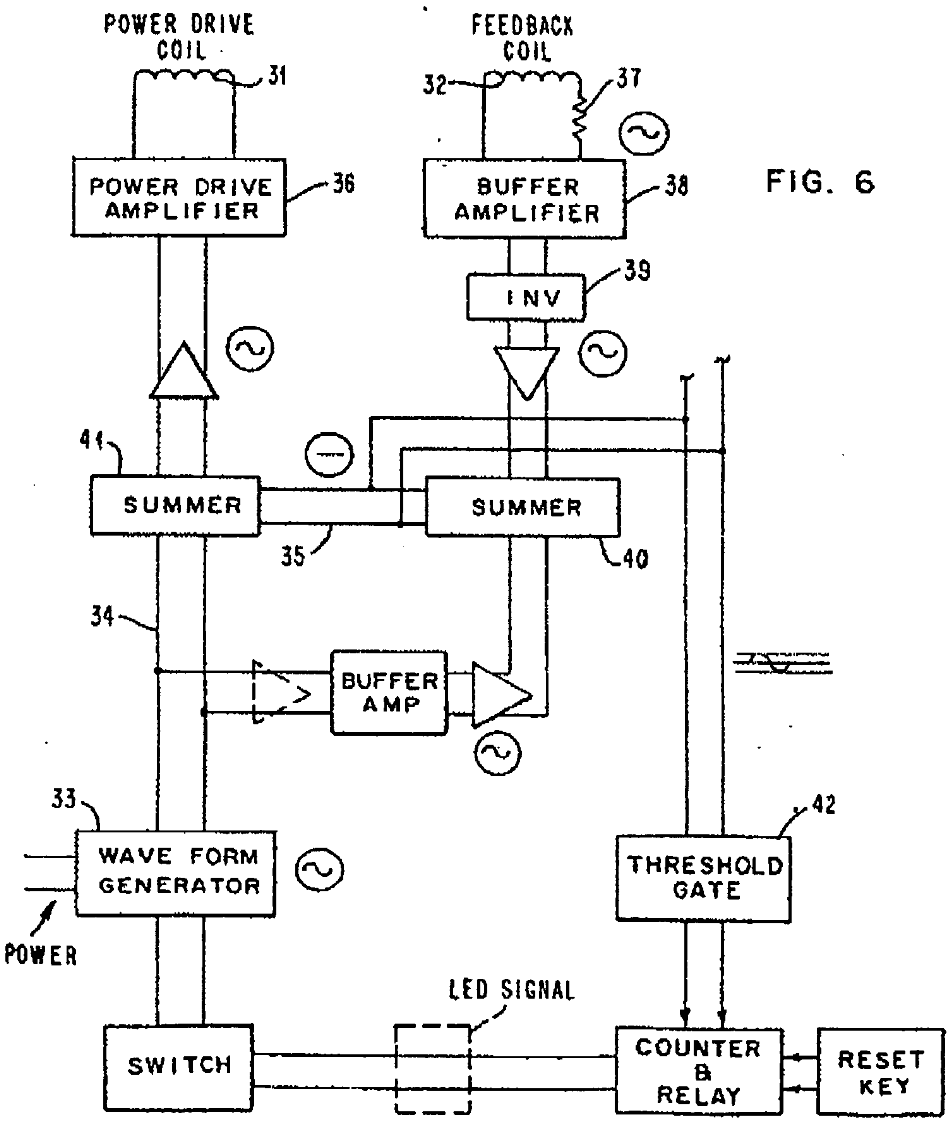


FIG. 6

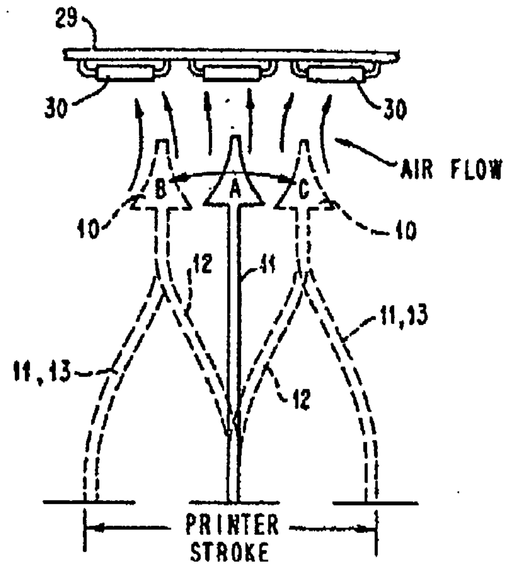

29
30
30
AIR FLOW
B
A
C
10
10
12
11
11,13
11,13
12
PRINTER
STROKE

FIG. 5

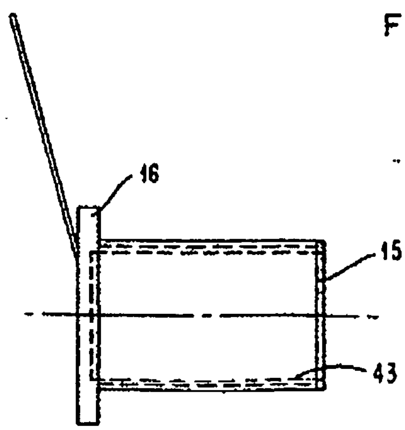

16
15
43

FIG. 7

FIG. 8

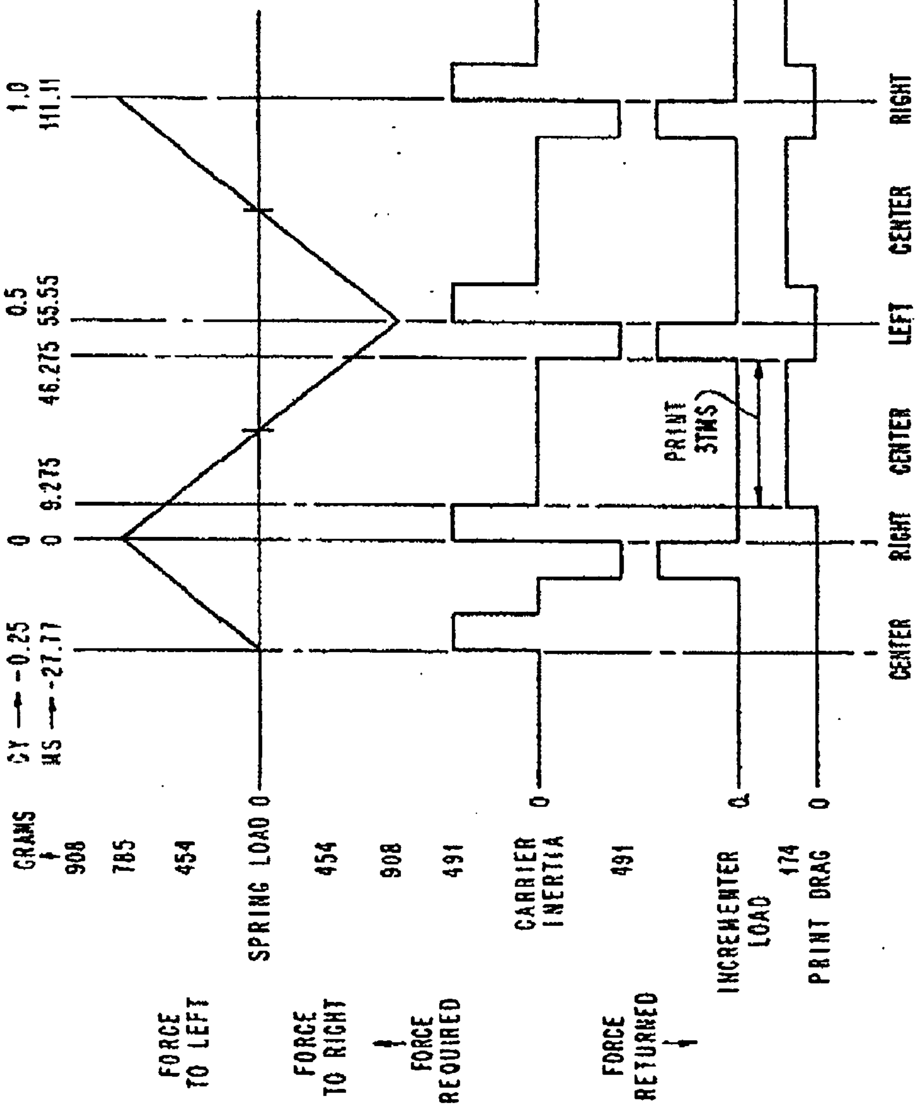

CY → -0.25
MS → -27.77
0
0
9.275
46.275
0.5
55.55
1.0
111.11
GRAMS
908
785
454
SPRING LOAD 0
454
908
491
CARRIER INERTIA 0
491
INCREMENTER LOAD 0
174
PRINT DRAG 0
FORCE TO LEFT
FORCE TO RIGHT
FORCE REQUIRED
FORCE RETURNED
PRINT 3TMS
CENTER
RIGHT
CENTER
LEFT
CENTER
RIGHT

FIG. 9

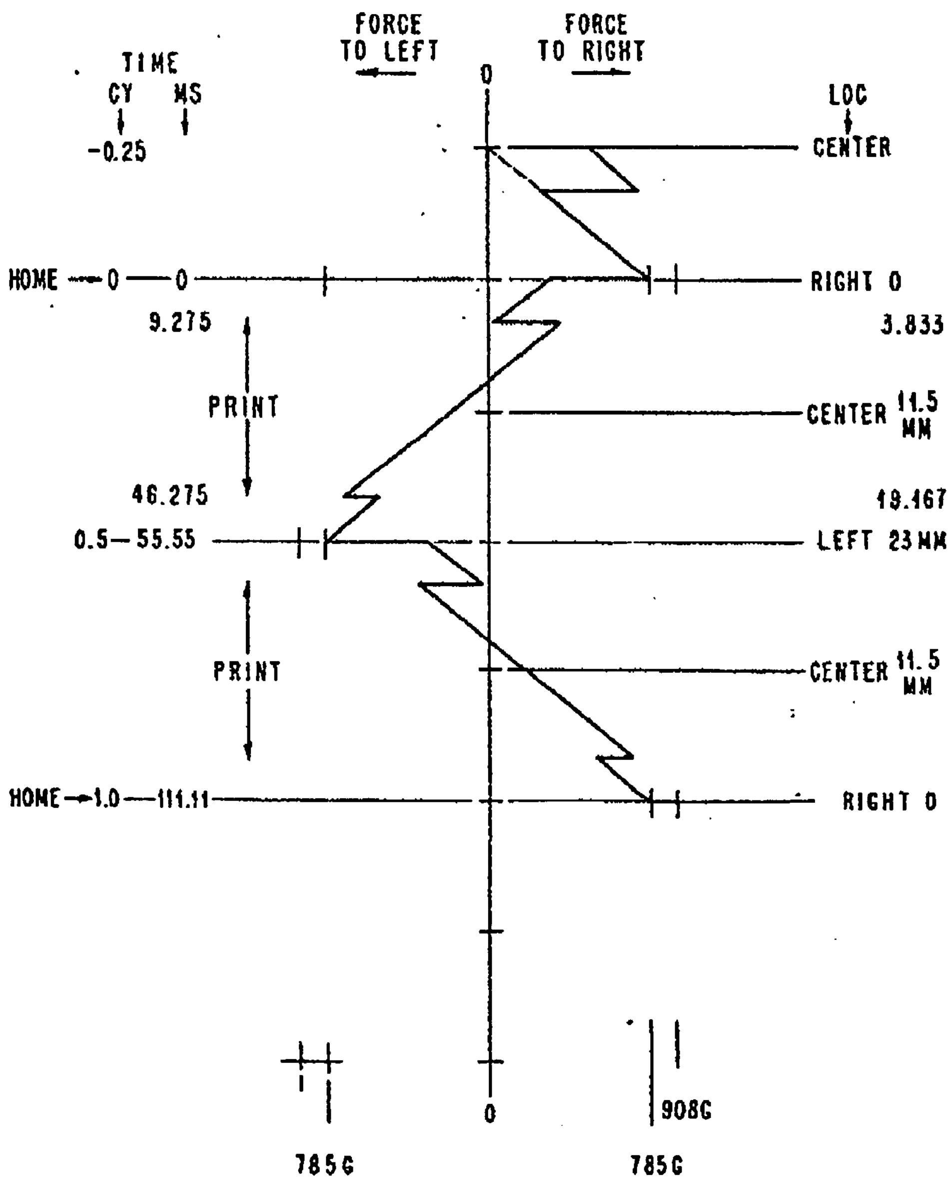

FORCE TO LEFT
FORCE TO RIGHT
TIME
CY
MS
-0.25
0
LOC
CENTER
HOME
0
0
RIGHT 0
9.275
3.833
PRINT
CENTER 11.5 MM
46.275
19.467
0.5—55.55
LEFT 23MM
PRINT
CENTER 11.5 MM
HOME—1.0—111.11
RIGHT 0
0
908G
785G
785G

FIG. 10

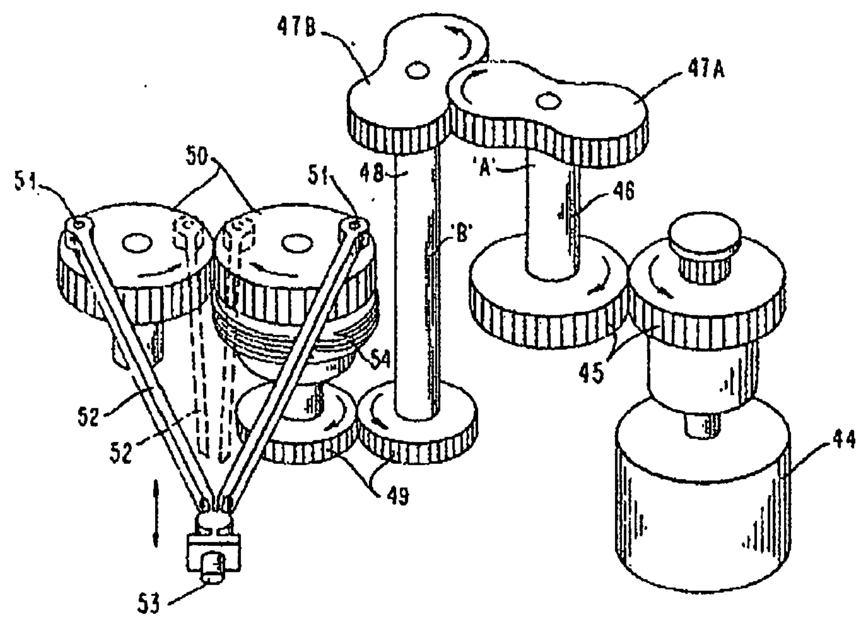


FIG. 12

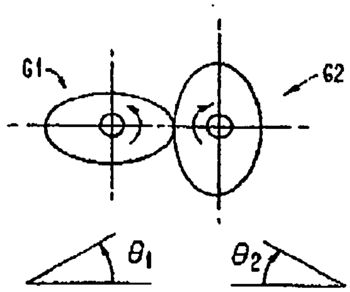


FIG. 13

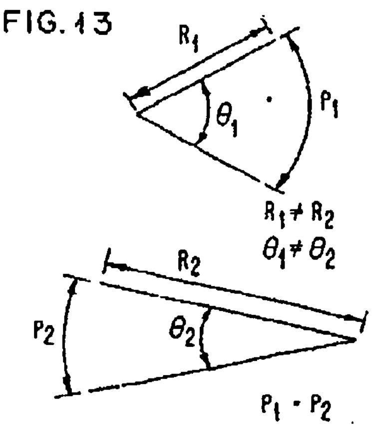
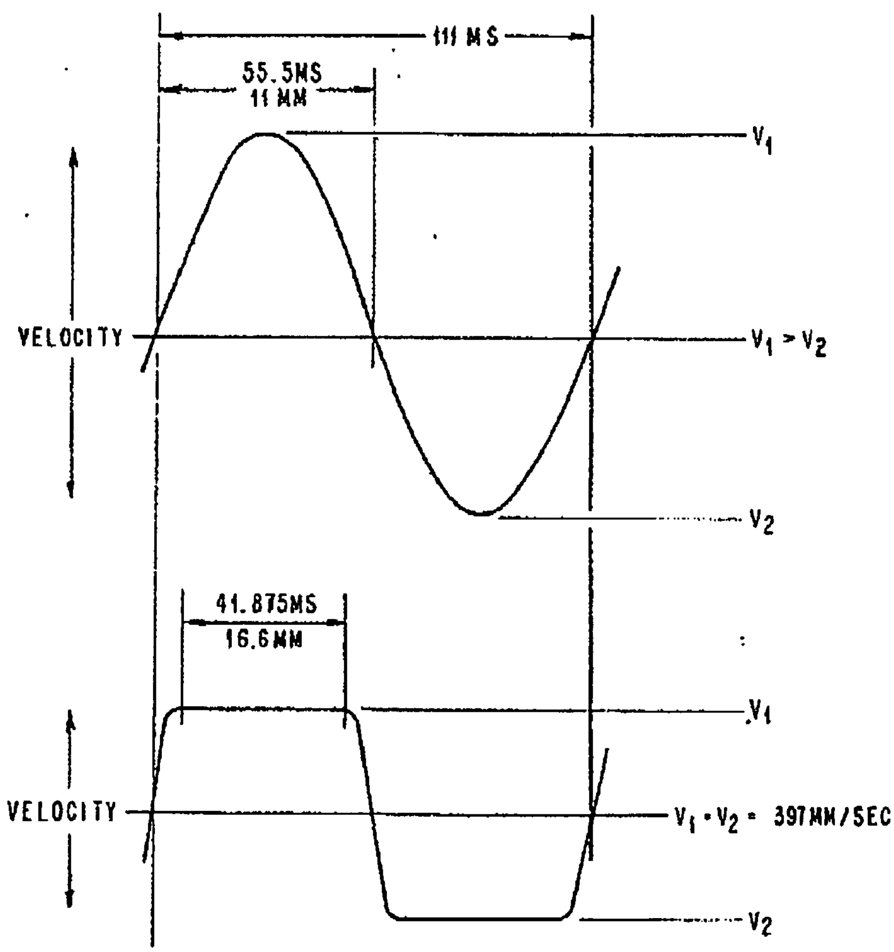


FIG. 11


111 MS
55.5MS
11 MM
V_1
VELOCITY
$V_1 > V_2$
V_2
41.875MS
16.6MM
V_1
VELOCITY
$V_1 = V_2 = 397$MM/SEC
V_2